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ABSTRACT

This study compared the areas of talent and career aspirations of boys and girls in Year 7 (n=398) and Year 11 (n=240) samples in a middle class metropolitan area in Australia. Students nominated the high school subject in which they saw themselves as being most talented, and current perceptions of talent in relation to each of their high school subjects were measured, along with career aspirations. For both age groups, more boys perceived themselves as most talented in mathematics, science, or technical domains, while more girls perceived themselves as most talented in the arts or humanities domains. More boys than girls perceived themselves as multi-talented. Analysis of career aspirations showed that boys more than girls planned to pursue mathematical careers. Theoretical and educational implications are drawn. (Contains 19 references.) (DB)

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Paper presented at the Singapore ERA & AARE Joint Conference, Singapore, November 25-29, 1996.

Students' Gendered Perceptions of Talent at High School According to Academic Domain, and their Effect on Career Aspirations

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Boys and girls nominated the high school subject in which they perceived themselves as being most talented, and current perceptions of talent in relation to each of their high school subjects were measured, along with career aspirations. The study objectives were to ascertain whether boys and girls differ in terms of the subjects at which they feel most talented, their talent ratings for each subject domain, and their career aspirations. Participants consisted of a Year 7 (N=398) and a Year 11 (N=240) sample from coeducational Government schools in an upper-middle class metropolitan area of Sydney. Results show that for both age groups more boys perceived themselves as being most talented in the mathematics, science or technical domain, while more girls perceived themselves as being most talented in the arts or humanities domain. Analysis of students' talent ratings for each subject they study reveal gender differences in the expected direction within the mathematics and humanities domains for Year 7, and the mathematics, technical, social science and humanities domains for Year 11. Analysis of career aspirations in terms of mathematical relatedness showed boys more than girls planned to pursue mathematical careers. More fine-grained analyses focusing only on students who perceived themselves as most talented at mathematics reflected the general findings in most respects. Theoretical and educational implications are first derived from girls' limited participation in mathematics-related careers in relation to their lower perceptions of mathematical talent; and second, boys' possibly restricted career paths, since many of them plan to pursue strongly mathematics-related careers despite feeling similarly talented to girls in non-mathematical domains.

In recent decades there has been increased awareness of the differential involvement in mathematical and technical careers by boys and girls, based on two main perspectives. Impetus has stemmed from first, a concern with individual rights and fulfilment and second, a realisation that we are not utilising the full pool of resources to aid national technological advance. In seeking explanations for this phenomenon, a sizeable body of research has focused on student perceptions and their impact on participation in mathematics.

A major theoretical model in this area has been the Expectancy-Value Theory of Achievement Motivation proposed by Eccles(Parsons) and colleagues, wherein mathematics participation is consequent upon expectation of success mediated by perception of ability, and subjective task value mediated by goals (Parsons, Adler, Futterman, Goff, Kaczala, Meece, & Midgley, 1983). Many studies have focused on specific elements of this model, notably the impact of perceived mathematical ability or mathematical self-concept on mathematics participation.

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Studies within this and related frameworks have tended to view limited post-school options as a result of limited participation in mathematics courses, and have focused on investigating and increasing female participation in high school mathematics (eg. Eccles, 1992; Eccles & Jacobs, 1986). The possibility that causality may be operating in the reverse direction has been raised (Armstrong & Price, 1982), with suggestion that due to a recognition of limited post-school options, girls elect not to participate in the higher levels of senior secondary school mathematics. In partial support of this thesis, one study found that mathematically competent girls are more likely to have multiple talents than mathematically competent boys, and that these girls' intention to study mathematics further was related to their conception of the range of their abilities, rather than their perception of mathematical ability (Hollinger, 1985).

Gendered Perceptions of Talent at High School

Within the self-concept theoretical perspective, recent studies have focused specifically on students' perceptions of mathematical talent (eg. Bornholt, Goodnow, & Cooney, 1994; Watt & Bornholt, 1994; Watt, 1995). While there is some controversy about the definition of self-concept (Kahne, 1996), with a range of research topics grouped under this term, perception of talent is clearly defined and readily understood.

Some studies have suggested that boys' perceptions are characterised by an 'illusory glow' (Bornholt, 1991), in which they perceive their performance as better than it actually is. However, mean differences have been found in boys' and girls' perceptions of talent in both mathematics (Bornholt, Goodnow, & Cooney, 1994; Watt & Bornholt, 1994) and English (Bornholt, Goodnow, & Cooney, 1994) at high school, with boys having higher perceptions of mathematical talent than girls, and girls having higher perceptions of English talent than boys. In the mathematics domain it has further been found that perception of talent predicts participation in senior high school mathematics courses over and above mathematical performance, with these variables together explaining a sizeable 60% of the variance in students' course level plans (Watt & Bornholt, 1994). Perception of talent may be a key student perception in terms of explaining participation in various school domains. There has been little investigation, however, of other academic domains at high school, and whether boys' 'illusory glow' may be evident across these domains. The present study measures girls' and boys' perceptions of talent across each high school domain.

Gendered Career Plans

It is a well recognised phenomenon that females are underrepresented (or males are overrepresented?) in careers involving a high degree of mathematics. To date, however, there has been little attempt to quantify this. An earlier study by the author (Watt & Bornholt, 1994) established a possible method of measuring students' planned involvement in mathematics-related careers, since student predictions have been found to be a good indicator of future behaviour (Carpenter & Fleishman, 1987).

Students with High Perceptions of Mathematical Ability

It is possible that students, both male and female, with high perceptions of mathematical ability, may have similar perceptions of their mathematical talent. Although it has been found that boys and girls overall have disparate perceptions of talent in mathematics, perhaps boys and girls who perceive themselves as being most talented at mathematics, may have comparable perceptions of talent in this domain. Also of significance is whether these boys and girls have similar profiles in terms of perception of talent in other academic domains, as well as in career plans. The issue raised earlier relating to whether mathematically competent girls are more likely to be multi-talented than boys can be investigated through student perception. That is, do girls who perceive themselves as highly talented at mathematics also perceive themselves as highly talented relative to boys in other academic domains. Clearly it is important to focus on this group of girls perceiving mathematics as the subject in which they are most talented, especially longitudinally, to determine whether these girls maintain their high perceptions, participate in high levels of senior mathematics and mathematics-related careers, or opt out of mathematics and fade away.

METHOD

Design

Proportions of boys and girls perceiving themselves as being most talented in each high school subject domain were compared for Year 7 and Year 11 students. Boys' and girls' perception of talent ratings in each domain were then compared, to determine whether gender differences in nominated talent domains were reflected in actual subject talent ratings. Planned participation in mathematics-related careers was contrasted for boys and girls, according to the extent to which mathematics is involved in nominated career plans. Parallel analyses were also conducted involving only students who perceive themselves as being most talented at mathematics. A subsidiary analysis of a sub-sample of Year 7 students examined whether gendered performance differences in various subject domains in the early high school years may be precursors of gender differences in student perceptions.

Participants

Participants were Year 7 (N=398) and Year 11 (N=240) students drawn from different coeducational Government schools in an upper-middle class metropolitan area of Sydney, all matched for socioeconomic status (ABS Index of Education and Occupation, 1995). Year 7 students came from three schools (Schools 1, 2 and 3) and Year 11 students were from two schools (Schools 4 and 5). The Year 7 students are part of a longitudinal study currently being undertaken, and will be followed through to Year 10. Distribution of students by Year, gender and school is shown in Table 1.

Table 1

Distribution of Students by Year, Gender and School

	Year 7			Year 11	
	boys	girls		boys	girls
School 1	93	92	School 4	46	26
School 2	91	56	School 5	83	83
School 3	43	23			
totals	227	171		131	109

Materials

Subjects at which Students Perceive Themselves as being Most Talented. A questionnaire measured school subjects at which students perceived themselves as being most talented. This formed part of a much larger study investigating student perceptions relating to expected success, effort required, effort exerted, task difficulty, interest, usefulness, status and sex-typing of mathematics and English, as well as parental and school influences on these. Students were asked to respond to the question 'What school subject are you most talented at?'. These subjects were categorised in terms of one of the mathematics, technical, science, social science, health, languages, humanities or arts domains.

Perceptions of Talent. Perceptions of talent in each high school domain were measured as part of the same questionnaire by student ratings from 1 (not at all talented) to 7 (very talented) for each high school subject studied.

Planned Participation in a Mathematics-Related Career. In the same questionnaire, students were asked to nominate what career they intended pursuing. These careers were categorised according to the amount of mathematics they involved, on a scale from 0 to 10. The grouping used was derived from judgements by teacher educators from two Sydney universities (see Watt & Bornholt, 1994 for details).

Performance. Measures of student performance in each school subject were subsequently obtained for a subsample of the participants, to determine whether any gender differences in perceptions and plans could possibly be related to performance differences. Year 7 students

(n=185) from School 1 were involved in this analysis using school examination results. These results are largely based on examination results for each academic domain, with a minor classwork or assignment component.

Procedure

Year 7 students from three schools were surveyed in 1995, while Year 11 students from two different schools were surveyed in 1994. The two administrations were actually two separate studies, with both involving substantial common questions which are the focus of the present report. All research was conducted with informed school, parental and student consent, and took place in the regular classroom. The researcher was present in each administration to give preliminary information and instructions, and to answer any questions during the administration.

Year 7 Administration. Year 7 students completed questionnaires investigating perceptions of talent in each high school domain, as well as perceptions of talent, expected success, effort required, subject difficulty, interest, usefulness, status and sex-typing in relation to mathematics and English, as well as their planned career. Students also completed standardised mathematics (ACER, 1984, Form 3B alternate items) and English tests (ACER, 1987, 'Iceberg Towing') following questionnaire completion. This involved two administrations so as not to overburden respondents, with mathematics surveying and testing taking place on one day, and English on the following day, in each of the three schools. Questionnaires took approximately 20 minutes to complete, and students were allowed 20 minutes on each test.

Year 11 Administration. Year 11 students completed a questionnaire investigating similar perceptions to the Year 7 questionnaire in relation to mathematics in particular. Completion of this survey took approximately 20 minutes after which questionnaires were collected. Following the questionnaire was a short standardised multiple-choice Progressive Achievement Test for mathematics (ACER, 1984, Form 3B), which took 20 minutes. Alternate items were chosen so the test could be administered in this time. Test and answer sheets were then collected, and students invited to ask any questions they might have about the study in the remaining time.

Analyses

The emphasis of the study focused on boys and girls, particularly in relation to their ipsative talent judgements in high school, their talent ratings for each high school subject and their career plans. Descriptive statistics were derived for the subject domain in which students perceived themselves as being most talented, talent ratings for each school subject, extent to which mathematics is involved in their planned career and, for School 1, performance in school examinations for each high school subject. Percentages of boys and girls perceiving themselves as being most talented in each academic domain were compared, multiple analyses of variance (MANOVAs) with gender nested within school tested for gender differences for perceptions of

talent, and the δ dominance statistic measured proportions of boys and girls who planned to pursue a mathematics-related career. A correlational analysis examined the relation between student perceptions and career plans. These analyses were conducted for boys and girls combined within each school Year, as well as separately for boys and girls perceiving themselves as being most talented at mathematics. For School 1, multiple analyses of variance (MANOVAs) investigated possible gender differences in performance for each Year 7 school subject.

RESULTS

Subjects at which Students Perceive Themselves as Being Most Talented

Year 7 Sample. Boys and girls differed in the subject domains in which they perceived themselves as being most talented. A greater proportion of boys (45%) perceived themselves as being most talented in the mathematics (22.8%), science (9.7%) or technical (12.1%) domain, compared with only 22% of girls. Further, 57% of girls considered themselves to be most talented in the arts (26.0%) or humanities (31.4%) domain, in contrast to only 31% of boys.

Figure 1 shows proportions of Year 7 boys and girls who perceive themselves as being most talented in the mathematics, science, technical, arts, humanities, languages, health and social science domains. Note that for Year 7, the only school subject in the health domain is sport, and the only social science offered is geography. Consequently a direct comparison between Year 7 and Year 11 students cannot be made in these two domains. Other subject domains for which proportions of boys and girls differed slightly in terms of perceiving themselves as being most talented were languages and sport. 3% more girls than boys perceived themselves as being most talented at languages, and 4% more girls than boys perceived themselves as most talented at sport.

Year 11 Sample. Similar trends were observed in the Year 11 sample. 51% of Year 11 boys perceived themselves as being most talented in the mathematics (17.4%), science (14.8%) or technical (19.1%) domain, compared with only 14% of Year 11 girls. Conversely, 51% of girls perceived themselves as being most talented in the arts (24.8%) or humanities (26.7%) domain, compared with only 20% of boys.

Figure 2 shows proportions of boys and girls who perceive themselves as being most talented in the mathematics, science, technical, arts, humanities, languages, health and social science domains. Proportions of boys and girls differed substantially for mathematics, technical, science, humanities and arts domains, and there were minor differences for social science and health. 4% more girls than boys perceived themselves as being most talented in the social sciences, and 3% more girls than boys perceived themselves as most talented in the health domain.

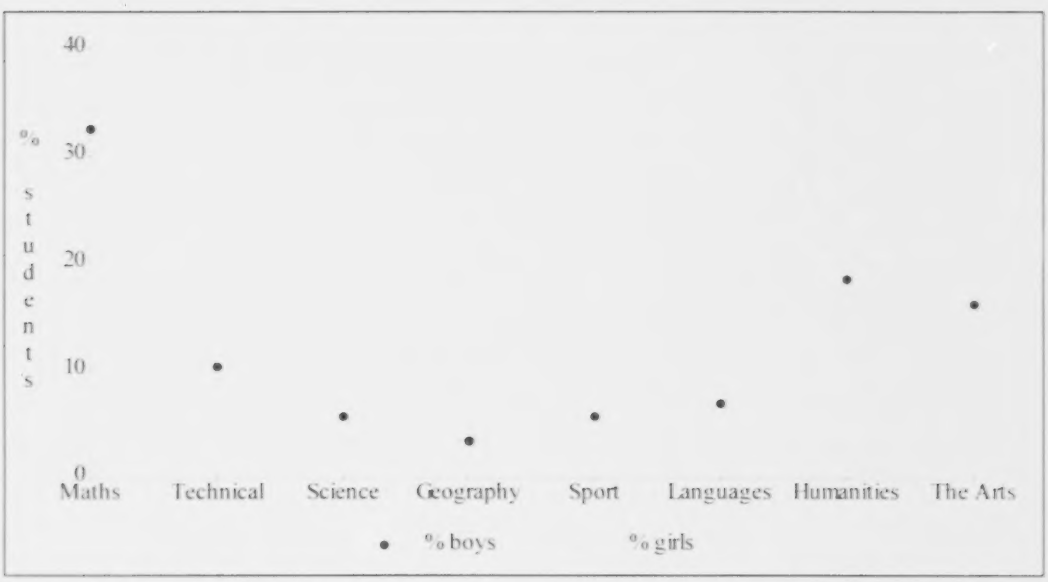

Figure 1. Subject domains in which Year 7 boys and girls perceive themselves as being most talented.

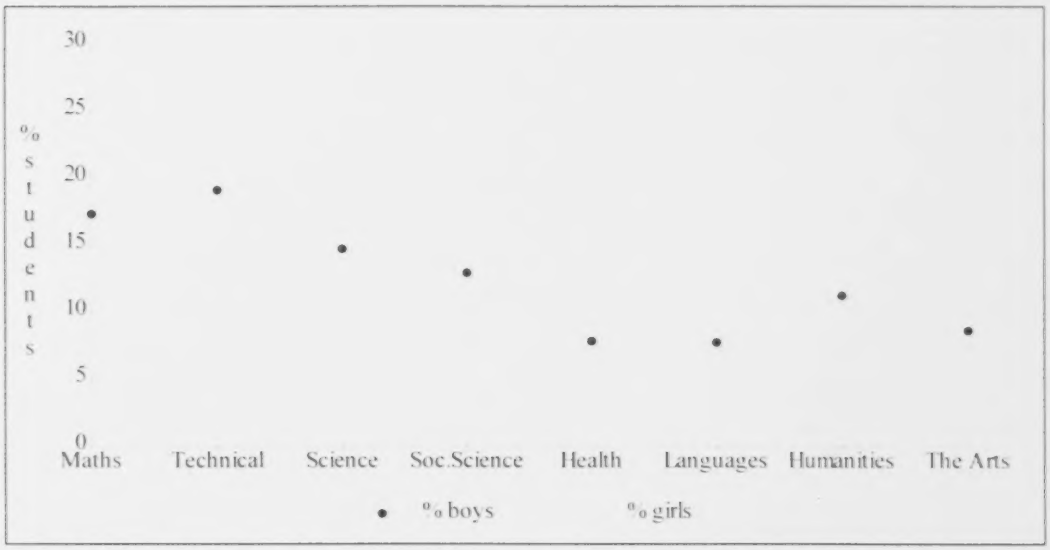

Figure 2. Subject domains in which Year 11 boys and girls perceive themselves as being most talented.

Students' Perceptions of Talent in Different Subject Domains

Year 7 Sample. For Year 7 students, gender differences were evident in students' perceptions of talent in the mathematics and humanities domains. Boys perceived themselves as more talented in mathematics (boys M=5.0 girls M=4.4, $F(3,324)=6.5$ $p<.001$), while girls perceived themselves as more talented at English (boys M=4.3 girls M=4.8, $F(3,324)=4.6$ $p=.004$). There were no differences in boys' and girls' talent ratings for any other high school subject.

Year 11 Sample. Gender differences in Year 11 students' talent ratings for each subject studied were found in the mathematics, technical, social science and humanities domains. Boys' perceptions of talent were higher then girls' both for mathematics in general (boys M=4.5 girls M=3.8, $F(3,226)=6.8$ $p=.001$), as well as for the 3-unit mathematics course (boys M=5.3 girls M=4.4, $F(3,63)=4.1$ $p=.02$). Boys also considered themselves more talented at computing (boys M=5.3 girls M=3.7, $F(3,47)=6.1$ $p=.005$) and geography (boys M=5.2 girls M=3.7, $F(3,43)=5.8$ $p=.006$). Girls' perceptions of talent were higher than boys' in the 2-unit General English course (boys M=4.1 girls M=4.7, $F(3,132)=3.9$ $p=.02$).

Plans for Participation in a Mathematics-Related Career

Boys' and girls' planned participation in mathematics-related careers were measured using dominance analysis, summarised by the d statistic, since proportions of each gender planning careers involving varying degrees of mathematics were of interest, and d measures the extent to which one sample distribution tends to lie above another. d is a point estimate of the population parameter δ (delta), where d is the difference in probabilities between any two randomly selected members selected one from each group. d measures the probability that any selected member of group one will lie above any selected member of group two. The d statistic also makes no distributional assumptions, and so was appropriate to the present data (Cliff, 1993). Since the d distribution is asymptotically equivalent to the z distribution, inferential statistics can also be simply derived by converting d to a z score and comparing this with the appropriate critical value.

A greater proportion of boys than girls from Year 7 intended to pursue a strongly mathematics-related career, with boys planning to participate in more strongly mathematical careers than girls 28% of the time ($d=.282$, $\sigma_d=.067$, $z=4.21$, $c.v.=1.96$). Table 2 shows proportions of Year 7 boys and girls planning to pursue careers requiring varying degrees of mathematics from 0 (no mathematics involved) to 10 (extremely high degree of mathematics involved). In Year 11 also there is a significant difference in proportions of boys and girls planning to pursue highly mathematics-related careers as shown in Table 2. The gender difference was more marked here than in Year 7, with Year 11 boys intending to participate in a more strongly mathematical career than girls 38% of the time ($d=.376$, $\sigma_d=.080$, $z=4.65$, $c.v.=1.96$).

Table 2

Extent to which Boys and Girls Plan to Pursue Mathematics-Related Careers

		degree of mathematics involved:							
		0-3	4	5	6	7	8	9	10
Year 7	% boys	-	2.9	9.3	32.9	7.9	20.0	21.4	5.7
	% girls	-	10.5	31.5	16.9	-	37.9	3.2	-
Year 11	% boys	-	5.5	14.3	14.3	11.0	19.8	14.3	20.9
	% girls	-	8.6	35.8	17.3	4.9	27.2	6.2	-

The Relation between Perception of Mathematical Talent and Planned Participation in a Mathematics-Related Career

Year 7 Sample. The relation between perception of mathematical talent and planned participation in a mathematics-related career was examined through correlational analysis. Relationships between student perceptions and plans were weak in the Year 7 sample, although it must be remembered that students in Year 7 are unlikely to have definite career plans at this age. For Year 7 students overall, Pearson's correlation was .25 ($p<.001$), for boys $r=.29$ ($p<.001$), and interestingly, there was no relation between perceptions and plans for Year 7 girls ($r=.14$, $p=.14$).

Year 11 Sample. For Year 11 students overall, Pearson's correlation between perceptions and plans was .44 ($p<.001$). For boys, $r=.42$ ($p<.001$), while the relation was slightly less strong for girls with $r=.37$ ($p<.001$).

Students who Perceive Themselves as being Most Talented at Mathematics

Similar analyses were conducted for students who perceive mathematics as the subject in which they are most talented. The importance of studying these students is clear, since it is vital to see what happens to these girls particularly, in terms of perceptions and plans for participation in mathematics. The longitudinal study of which these Year 7 are a part aims to focus on the development of these girls. Numbers of boys and girls perceiving themselves as being most talented at mathematics at high school were 46 boys and 21 girls from Year 7 (n=67), and 20 boys and 7 girls from Year 11 (n=27).

Perceptions of Talent in Different Subject Domains for Students Perceiving Themselves as Most Talented at Mathematics

Year 7 Sample. Year 7 students study common academic subjects throughout the calendar year, enabling comparison of the same students for their perceptions of talent in each academic subject. Figure 3 shows mean talent ratings in each academic domain for boys and girls perceiving mathematics as the subject in which they are most talented. Boys and girls perceiving

themselves as most talented at mathematics rated their talent similarly in all academic domains except for art (boys M=4.7 girls M=4.8, F(3,55)=4.7 p=.005) in which girls had higher perceptions of talent than boys, although the effect size was negligible, and mathematics (boys M=6.4 girls M=6.3, F(3,61)=4.4 p=.007), in which boys perceived themselves as more talented than girls. This difference in perception of mathematics talent parallels the difference already reported for Year 7 boys and girls overall, despite these students having identified mathematics as their area of major talent. Interestingly, there were no differences in perception of English talent for this group.

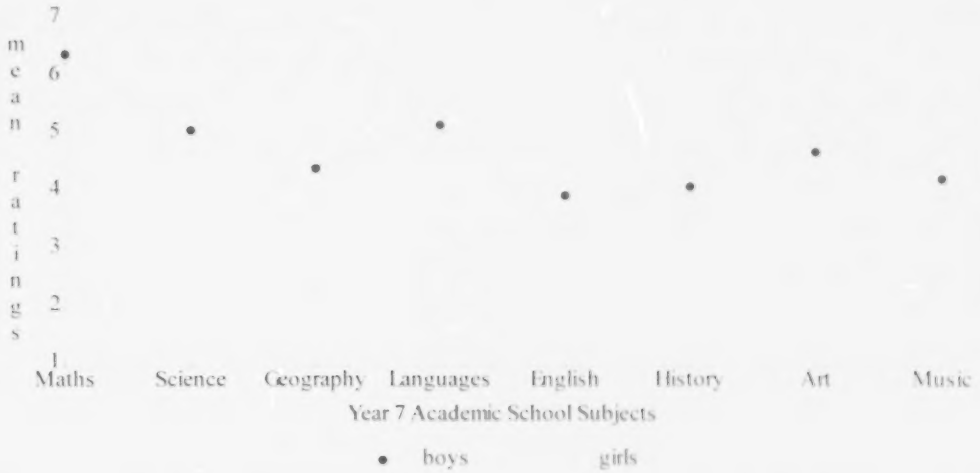

Figure 3. Mean talent ratings for Year 7 boys and girls perceiving themselves as most talented at mathematics.

Year 11 Sample. Boys' and girls' mean talent ratings in each of the mathematics, technical (Computing), science (Physics, Chemistry, Biology), social science (Geography, Economics), languages (Japanese), humanities (2-unit Related English, 2-unit General English, 2-unit Contemporary English, History) and arts (Art, Music, Visual Design) domains were compared. Since Year 11 students have much flexibility in their course selections, there are various electives within each academic domain, and not all students study the same courses. Consequently the numbers of boys and girls in each course differs. No girls in this sub-sample studied Biology or History. Other academic subjects where numbers of boys or girls were very low (< 5) are Computing (1 girl), Geography (2 girls), Economics (2 girls), Japanese (4 boys, 2 girls), 2-unit Related English (1 boy, 1 girl), Contemporary English (1 girl), History (1 boy) and The Arts (2 girls). Interpretation of students' perceptions of talent are therefore problematic, since different students are being compared in each academic subject, and numbers are too small to test for significance in each case. Figure 4 shows mean talent ratings for Year 11 boys and girls in academic domains in which there were at least 5 boys and 5 girls represented.

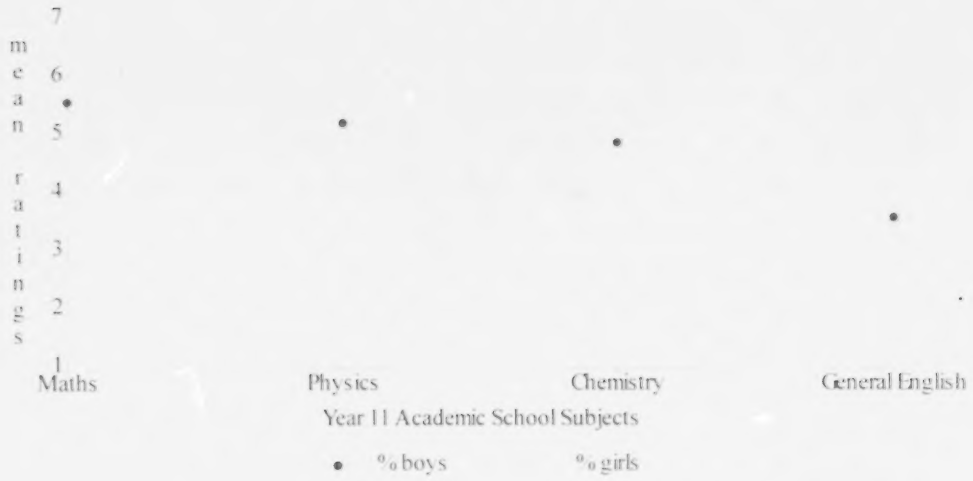

Figure 4. Mean talent ratings for Year 11 boys and girls perceiving themselves as most talented at mathematics.

Plans for Participation in a Mathematics-Related Career for Students Perceiving Themselves as Most Talented at Mathematics

Year 7 Sample. Proportions of Year 7 boys and girls planning to pursue careers involving different degrees of mathematics are shown in Table 3. As in the analysis of Year 7 boys and girls overall, there was once again a difference in the distribution of mathematically-related career plans for boys and girls perceiving themselves as most talented at mathematics, with the boys planning to participate in more mathematical careers than girls 37% of the time ($d=.372$, $\sigma_d=.161$, $t=2.3$, $c.v.=2.0$).

Year 11 Sample. Proportions of Year 11 boys and girls planning to pursue careers involving various degrees of mathematics are also shown in Table 3. As in the case of Year 11 boys' and girls' plans overall, for students perceiving themselves as most talented at mathematics, more boys than girls intend to pursue strongly mathematics-related careers, with boys planning more strongly mathematical careers than girls 56% of the time ($d=.558$, $\sigma_d=.266$, $t=2.1$, $c.v.=2.1$). No girls plan to pursue careers involving the highest level of mathematics, while this highest level of mathematics involvement is actually the modal category for boys, with the modal category for girls being substantially lower (8).

Table 3

Extent to which Boys and Girls Perceiving Themselves as Most Talented at Mathematics Plan to Pursue Mathematics-Related Careers

		degree of mathematics involved								
		0-3	4	5	6	7	8	9	10	n
Year 7	% boys	-	3.4	-	31.0	-	37.9	24.1	3.4	29
	% girls	-	7.1	21.4	28.6	-	35.7	7.1	-	14
Year 11	% boys	-	-	-	-	18.2	9.1	9.1	63.6	11
	% girls	-	-	-	14.3	-	57.1	28.6	-	7

Boys' and Girls' School Performance in each Year 7 Academic Domain

School results in the mathematics, technical (Design and Technology), science, social science (Geography), languages (Japanese), humanities (English, History) and arts (Music, Visual Arts) domains were analysed by gender to determine whether performance levels may be precursors of differences in perceptions and plans. Students from School 1 (n=185) were involved in this analysis. Boys and girls performed similarly in mathematics and Japanese. Interestingly, girls outperformed boys on average in every other subject. Table 4 shows mean results and significance levels for boys and girls in each academic subject.

Table 4

Mean Performance of Year 7 (School 1) Boys and Girls in each Academic Domain

	boys		girls				
	mean(%)	(SD)	mean(%)	(SD)	n	F	p
Maths	67.6	(18.5)	71.5	(13.9)	177	2.5	.12
D&T	71.7	(14.3)	80.8	(9.7)	177	24.4	<.001
Science	67.1	(13.7)	72.3	(12.1)	176	7.3	.008
Geography	72.4	(17.8)	83.0	(11.9)	177	21.7	<.001
Japanese	57.9	(26.3)	67.7	(27.5)	54	1.8	.19
English	56.3	(12.6)	70.6	(11.4)	177	63.4	<.001
History	63.8	(16.7)	69.6	(16.1)	177	5.5	.02
Music	61.9	(17.8)	77.3	(12.6)	177	44.9	<.001
Visual Arts	69.0	(10.8)	77.3	(6.8)	176	37.5	<.001

DISCUSSION

As expected, boys and girls differed in the academic domains in which they perceived themselves as being most talented, in their perceptions of talent in both mathematics and English, and in the extent to which they planned to pursue mathematics-related careers. This was found to be the case both for the Year 7 and the Year 11 students. The closer analysis focusing on students who perceived themselves as being most talented at mathematics largely reflected the general findings. In the subsidiary analysis involving the Year 7 sub-group, it was found that gender differences in student perceptions and plans did not seem to reflect differences in performance.

Subjects at which Students Perceive Themselves as Being Most Talented

The academic domains in which students perceived themselves as being most talented were different for boys and girls. In two different age groups drawn from different schools, it was found that a much larger proportion of boys perceived themselves as being most talented in the mathematics, technical or science domain, while a much larger proportion of girls perceived themselves as being most talented in the humanities or arts domain. Previous research has examined students' perceptions in both the mathematics and humanities (focusing mainly on English) domains, but little research has examined student perceptions in academic domains other than these. The present study has revealed that commonly held beliefs relating to the sex-typing of certain academic domains, namely the mathematics/science/technical domains as opposed to the arts/humanities domains, are reflected in student perceptions. Further, earlier research has generally quantified and then compared overall student perceptions in academic subjects, without placing any special focus on the subgroup of girls who perceive mathematics as their area of major talent. There has been an implicit assumption that mean differences (or similarities) apply across the whole group. The present study, by going beyond this in closely examining those students who perceive mathematics as the subject in which they are most talented, has identified important similarities between these students and the overall group, possibly justifying past studies which have not examined this subgroup separately.

In addition, the collection of the two measures of perceived talent enabled analysis of boys' and girls' perceptions using both an internal and external frame of reference (Marsh, 1986). Earlier research has generally used rating measures of talent or self-concept only. However, it is conceivable that although girls might rate their talent at mathematics lower than boys, they might still perceive themselves as more talented at mathematics than in other academic domains. The present study has established that this is not the case. Fewer girls perceive themselves as being most talented at mathematics (internal frame of reference), and girls on average rate their talent at mathematics lower than boys (external frame of reference).

Students' Perceptions of Talent in Different Subject Domains

Boys and girls had disparate perceptions of talent in mathematics and English in both the Year 7 and Year 11 samples. Year 11 boys also perceived themselves as more talented than girls did in the technical (computing) and social science (geography) domains. It seems then that gender differences in student self-perceptions in relation to mathematics and English are quite robust, appearing reliably in two samples unrelated in age and location. Other differences in perception may be related to progression through high school, or may be explained by the increasing specialisation in academic subject choice in senior high school.

Plans for Participation in a Mathematics-Related Career

More boys than girls plan to participate in strongly mathematics-related careers. This difference was again apparent at both age levels and supports previous research findings (eg: Watt & Bornholt, 1994) as well as commonly held beliefs. The gender difference in the greater proportion of boys planning to pursue strongly mathematical careers is larger for the older students. This may be a consequence of progression through high school, or perhaps related to the younger students' lack of certainty about career plans.

The relation between perception of mathematical talent and planned participation in a mathematics-related career was stronger for boys than girls at both year levels, but stronger for the older students. There was a moderate correlation between perceptions and plans for Year 11 boys and girls, with the relation slightly stronger for boys than for girls. There was a weaker correlation between Year 7 boys' perceptions and plans, and no relationship at all between the two for Year 7 girls. The longitudinal study will trace changes in student perceptions to identify their source.

It seems that boys' intended careers in terms of their mathematical relatedness are more associated with their perceptions of talent than is the case for girls. Also, it appears that boys are, at an earlier age than girls, planning participation in mathematics-related careers.

Students who Perceive Themselves as being Most Talented at Mathematics

Perceptions of Talent in Different Subject Domains. Among Year 11 students perceiving themselves as being most talented at mathematics, it was not possible to compare these students' perceptions of talent in each academic domain, owing to the small number of Year 11 girls perceiving themselves as most talented at mathematics, and the range of courses studied by Year 11 students. The Year 7 students were, however, compared in each academic domain. Despite these students all having identified mathematics as their area of major talent, boys still had higher perceptions of mathematical talent than girls, while girls had higher perceptions of art talent than boys.

Plans for Participation in a Mathematics-Related Career. Career plans involving mathematics were similar to the overall findings for students perceiving themselves as most talented at mathematics in both Year 7 and Year 11. More Year 7 boys than girls planned to pursue careers involving high degrees of mathematics, and a greater proportion of the Year 11 boys than girls also intended to pursue a strongly mathematics-related career.

Year 7 Boys' and Girls' School Performance in each Academic Domain

In order to explore whether differences in boys' and girls' perceptions and plans had their basis in dissimilar performance, school results were compared for a subgroup of Year 7 students (School 1). It was not possible to perform similar analyses with Year 11 students, since there is such variability in course selection in senior high school that performance measures on a set of common academic subjects cannot be obtained.

Mean similarities were found for boys and girls in the mathematics and languages domains, implying that disparate mathematical performance could not be the basis for gender differences in perceptions and plans relating to mathematics. In every other subject however, girls outperformed boys. It seems that girls' higher performance in English may be a logical basis for girls' higher perceptions of talent at English, with students being influenced by level of success, but not differentially by gender. Other research has also found gender differences in English-related tasks (eg: Skaalvik & Rankin, 1994). It seems that boys have higher perceptions than warranted by performance in mathematics, while girls may logically be expected to have higher perceptions of English talent than boys. Girls may also underrate (or boys overrate) their abilities in the science, technical and social science domains, since their superior performance is not reflected in higher perceptions of talent. These data could be explained by the notion of the 'illusory glow', which suggests that boys have higher perceptions than their performance would indicate. Hence, with the possible exception of English, Year 7 students' perceptions and plans do not appear to have their bases in academic performance.

Conclusion

Clearly the reality of gender differentiated performance and perceptions in mathematics and English is still very much an issue. Boys still perceive themselves as more talented than girls in mathematics, while the reverse is true in English. Analyses focusing on students perceiving themselves as highly talented at mathematics reveal that these boys also perceive themselves as more talented than girls in mathematics, with girls having higher perceptions of talent than boys in the art domain. Boys intend to pursue more strongly mathematics-related careers than girls, and this is true even among boys and girls perceiving themselves as most talented at mathematics. Comparison of performance measures at Year 7 reveal that academic performance did not indicate a relation to gender differences in mathematical talent perceptions and career plans.

In relation to the issue raised earlier, whether girls perceiving themselves as highly talented at mathematics are more likely to perceive themselves as multi-talented than boys (Hollinger, 1985), the data offer only limited support. The present study examined students' perceptions of mathematical talent rather than some more objective indicator, and found that only in the art domain did girls perceiving themselves as mathematically talented have higher perceptions of talent than boys, although this may be based on higher actual academic performance. Boys had higher perceptions of mathematical talent than girls in this group however, despite boys and girls having named mathematics as the subject in which they were most talented. It is possible that this subgroup of girls would opt for English- rather than mathematics-related careers due to a recognition of limited post-school options in careers involving mathematics (Hollinger, 1985). However, if girls are making an informed choice not to participate in careers involving mathematics, and instead electing humanities based careers, should educators try to change this? In both this analysis and in the overall analysis, girls' plans to participate in less mathematical careers than boys are consonant with their lower perceptions of mathematical talent. However, among students perceiving themselves as most talented at mathematics the only subject in which girls had higher talent perceptions than boys was art: there were no gender differences in English perception among these students. It is unclear then what the basis for these girls' planned lesser participation in mathematical careers may be, apart from their lower perceptions of mathematical talent. Interestingly there was a weaker relation between girls' perceptions of mathematical talent and career plans involving mathematics than for boys. This may suggest that different operative factors lie behind boys' and girls' career plans.

It seems that boys rather than girls perceive themselves as multi-talented, since they have similar or higher perceptions of talent in all academic domains excepting English, despite performing less well than girls in each of these areas. Does this mean that boys are aspiring to pursue mathematics-related careers over other options, on some basis other than their perceived abilities in academic domains? Are sex-typed societal pressures acting to restrict the range of career paths that are attractive to boys? Despite feeling similarly talented to girls in non-mathematical domains (excepting English), boys elect to pursue strongly mathematics-based careers. In any case, should this be a cause for concern? Regardless of how talented the boys feel, they do not perform as well as girls in these domains. Rather than investigating why boys do not pursue humanities-related careers despite feeling talented in these areas, and encouraging boys to pursue careers related to academic subjects in which they perceive themselves as talented, should educators strive to foster perceptions and choices that are realistically reflective of academic performance?

The present study has confirmed earlier sex-typed findings of gender differences in student perceptions in mathematics and English. It has also examined gender differences in other academic domains, finding gender differences in the expected direction where they occur. The

measures used enabled comparison of boys and girls with both and internal and external frames of reference, concluding that more boys consider themselves to be most talented at mathematics, and that boys also rate their mathematical talent higher than girls. Conversely, more girls perceive themselves as most talented at English, and rate their English talent higher than boys. The fact that these differences appeared in two different age groups in samples drawn from different schools adds to the robustness of the results. The first seems unrelated to performance, since boys and girls have been found to have similar mean performance in mathematics (Friedman, 1989; Hyde, Fennema, & Lamon, 1990), as reflected in the subsidiary analysis carried out with Year 7 students here. The second may have a logical basis in gender differences in English performance.

The close analysis of students perceiving mathematics as their area of major talent reveals that these girls also have lower perceptions of mathematical talent relative to their male counterparts, as was evident in the overall analysis. Further, these girls perceiving themselves as being most talented at mathematics plan to participate in less mathematical careers than their male counterparts, as was also evident in the overall analysis. It is not clear what factors may determine these girls' talent perceptions and career plans, since they rate their mathematical talent highly using an internal, but not an external frame of reference. In summary, the study has confirmed much, and distinctively added to current research by extending analysis of gender differences in student perceptions beyond the mathematics and English domains, and beyond using an external frame of reference only, revealing a discrepancy in findings using each frame of reference. The closer analysis of students perceiving themselves as most talented in mathematics has also yielded interesting information, since these girls do not share the relatively higher perceptions of English talent evident in the overall comparison of boys and girls. The development of these girls in particular will be a focus of the longitudinal study.

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